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Pollution Prevention at the Lawrence Livermore National Laboratory Rapid Prototype Facility*

Serge E. Peluso, Jr., Ralph J. Hersey, Jr. and Raymond A. Gonfiotti

The Electronics Engineering Department at Lawrence Livermore National Laboratory has taken several steps to improve pollution control at its Rapid Prototype Facility, one of several electronics fabrication facilities maintained on-site. Metal finishing, circuit board etching, and flux removal operations, traditionally using solvents high in volatile organic compounds (VOCs), are now carried out in part with aqueous-based cleaners. These solutions, combined with alternative cleaning units, have decreased pollution sources at the facility, which is dedicated to the construction of one-of-a-kind electronic apparatus, including printed circuit boards and chassis.

The Rapid Prototype Facility has among its other features a metal finishing line in which the surfaces of aluminum and aluminum alloy parts are prepared for use in electronic chassis. Degreasing, cleaning, and chemical etching, combined with a chemical conversion coating process, improve the surface electrical grounding characteristics and serve as a primer for painting. Before the advent of aqueous cleaning solutions, a vapor degreaser with trichloroetheylene or chlorofluorocarbon (CFC) solvent was used for degreasing. The next process steps used a mild-alkaline soap cleaner followed by a concentrated alkaline aluminum etching solution, which left a smut on the surfaces of parts. This smut was removed using a chromic acid cleaner, followed by a mineral acid cleaner and finally by a chromate chemical conversion coating solution. Both the de-smutting and conversion coating solutions contained chromic acid. Not only was the chromic acid cleaner dangerous in its own right, but the solution contained a cyanide compound.

Recently, the facility converted to an aqueous based degreaser system to remove oils from fabricated parts. The metal parts cleaning operation now uses a combination of aqueous based solutions and ultra sonic parts washers. The de-smutting operation now uses a dilute nitric acid solution, which eliminates chrome waste, and the chemical conversion coating process is changed to an equivalent that is cyanide free. The metal finishing operation however, still has a di-chromate in the conversion coating compound. In the near future we plan to replace chrome containing compounds with a chrome-free chemical conversion coating. In the circuit board assembly process, we will replace the current CFC-based solder flux removal step with a technique that uses a hybrid washing unit, designed in part at LLNL, and employing aqueous solutions. Finally, our screen printing process still uses solvent-based inks and cleaners. We are looking for commercially available inks and cleaners with low or no VOC components.

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Title:	Pollution Prevention at the Lawrence Livermore National Laboratory Rapid Prototype Facility
Presenting Author:	Serge E. Peluso Jr.
Organization:	Lawrence Livermore National Laboratory
Phone:	510 422 6247 fax: 510 422 2495
Address:	University of California Lawrence Livermore National Laboratory P.O. Box 808, Livermore Ca. 94550 Mail Stop L130
E-Mail	peluso1@llnl.gov
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Serge Peluso is a Senior Engineering Associate at the Lawrence Livermore National Laboratory. He has worked in the Laser Engineering and Computers and Communication Engineering Divisions for the past seventeen years. He is presently Facility and Assurance Manager for the Electronics Engineering Department supporting several facilities including the Rapid Prototype Facility. He is actively involved in Waste Minimization and ES&H compliance at the Lab.